Technical Memorandum

Preliminary Ecological Risk Assessment
For the
Impact Area, Parcel 136Q-X

Fort McClellan
Calhoun County, Alabama

This Technical Memorandum presents the Preliminary Ecological Risk Assessment (PERA) for the Impact Area (Parcel 136Q-X) at Fort McClellan (FTMC) located in Calhoun County, Alabama. The PERA approach is a shortened version of the Screening-Level Ecological Risk Assessment (SLERA) protocol which has been developed for FTMC as a means to evaluate numerous sites in a uniform and economical way. It is assumed that the reader is familiar with FTMC and the fundamentals of the SLERA protocol presented in the Installation-Wide Work Plan (IT Corp., 1998). Each step of the PERA is described in the following sections.

Ecological Habitat Description. The Impact Area (Parcel 136Q-X) is approximately 4 acres in size and is located in the northeastern area of FTMC Main Post. The area of investigation has been expanded to include a possible training area south of Parcel 136Q-X and encompasses an area of approximately 16 acres. The study area slopes towards the west, with an overall elevation change of approximately 175 feet from the eastern side of the study area to the western side of the study area. A dirt road bisects the southwestern corner of the study area and another dirt road runs along the northwestern corner of the study area. The entire study area is forested with a mature mixed deciduous/coniferous forest. The cover species typically found in these forested areas include scrub pine (*Pinus virginiana*), loblolly pine (*Pinus taeda*), white oak (*Quercus alba*), post oak (*Quercus stellata*), chestnut oak (*Quercus prinus*), southern red oak (*Quercus falcata*), wild black cherry (*Prunus serotina*), hackberry (*Celtis occidentalis*), black walnut (*Juglans nigra*), and flowering dogwood (*Cornus florida*). These mixed deciduous/coniferous forests exhibit sparse, shade-tolerant undergrowth species such as *Parthenocissus quinquefolia* (Virginia creeper), *Polystrichum acrotichoides* (Christmas fern), *Toxicodendron radicans* (poison ivy) and *Vitis rotundifolia* (muscadine grape). Understory and shrub species are typically sparse in this type of habitat. A mat of pine needles and leaves generally inhibits the growth of shrub and herbaceous layers within this forest type. Typical terrestrial species inhabiting this type of habitat include eastern gray squirrel (*Sciurus carolinensis*), whitetail deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo*), shorttail shrew (*Blarina brevicauda* or *Blarina carolinensis*), red fox (*Vulpes vulpes*), white-footed mouse (*Peromyscus leucopus*), American robin (*Turdus migratorius*), and red-tailed hawk (*Buteo jamaicensis*).

There are no permanent water bodies or wetlands associated with the Impact Area (Parcel 136Q-X). A small ephemeral drainage ditch is present in the southwestern corner of the study area.

Media of Interest and Data Selection. The medium of interest at the Impact Area is surface soil. Since there are no wetlands or perennial surface water bodies associated with the Impact Area, surface water and sediment exposures are not applicable. Exposures to subsurface soil and groundwater are unlikely for ecological receptors at this study area. Ten surface and depositional soil samples were collected and analyzed for metals, volatile organic compounds (VOC), semivolatile organic compounds (SVOC), pesticides, herbicides, and explosives.

Identification of Constituents of Potential Ecological Concern. In order to determine whether constituents detected in environmental samples collected at the Former Rifle/Machine Gun Range have the potential to pose adverse ecological risks, screening-level hazard quotients were developed. The screening-level hazard quotients were developed via a three-step process as follows:

- Comparison to Ecological Screening Values (ESVs);
- Identification of essential macro-nutrients; and
- Comparison to naturally-occurring background concentrations.

The ecological screening values (ESV) used in this assessment represent the most conservative values available from various literature sources and have been selected to be protective of the most sensitive ecological assessment endpoints. These ESVs have been developed specifically for FTMC in conjunction with EPA Region 4 and are presented in the *Final Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000). The ESVs used in this assessment are based on no-observed-adverse-effect-levels (NOAEL) when available. If a NOAEL-based ESV was not available for a certain constituent, then the most health-protective value available from the scientific literature was used in this assessment.

Constituents that were detected in surface soil at the Impact Area were evaluated against the ESVs by calculating a screening-level hazard quotient (HQ_{screen}) for each constituent. An HQ_{screen} was calculated by dividing the maximum detected constituent concentration in surface soil by its corresponding ESV as follows:

$$HQ_{screen} = \frac{MDCC}{ESV}$$

where:

HQ_{screen}	=	screening-level hazard quotient;
$MDCC$	=	maximum detected constituent concentration; and
ESV	=	ecological screening value.

A calculated HQ_{screen} value of one indicated that the MDCC was equal to the chemical's conservative ESV and was interpreted in this assessment as a constituent that does not pose the potential for adverse ecological risk. An HQ_{screen} value less than one indicated that the MDCC was less than the conservative ESV and that the chemical is not likely to pose adverse ecological hazards to most receptors. Conversely, an HQ_{screen} value greater than one indicated that the MDCC was greater than the ESV and that the chemical might pose adverse ecological hazards to one or more receptors.

In order to better understand the potential risks posed by chemical constituents at the Impact Area, a mean hazard quotient was also calculated by comparing the arithmetic mean constituent concentration in surface soil to the corresponding ESV. The calculated screening-level hazard quotients for constituents in surface soil at the Impact Area are presented in Table 1.

EPA recognizes several constituents in abiotic media that are necessary to maintain normal function in many organisms. These essential macro-nutrients are iron, magnesium, calcium, potassium, and sodium (EPA, 1989). Most organisms have mechanisms designed to regulate nutrient fluxes within their systems; therefore, these nutrients are generally only toxic at very high concentrations. Essential macro-nutrients were considered COPECs only if they were

present in site samples at concentrations ten times the naturally-occurring background concentration.

A study of the natural geochemical composition associated with FTMC (SAIC, 1998) determined the mean concentrations of 24 metals in surface soil, surface water, and sediment samples collected from presumably non-impacted areas. Per agreement with USEPA Region IV, the background threshold value (BTV) for each metal was calculated as two times the mean background concentration for that metal. The BTV for each metal was used to represent the upper boundary of the range of natural background concentrations expected at FTMC and was used as the basis for evaluating metals concentrations measured in site samples. Another useful measure of the naturally occurring background concentrations of inorganic compounds is the upper background range (UBR). The UBR is the maximum detected concentration of a given inorganic chemical in presumably non-impacted soil. Naturally occurring concentrations of inorganic compounds are most accurately presented as ranges, and the UBR represents the upper limit of the range of background concentrations. It should be noted that UBRs are provided as additional information for risk managers.

In order to determine whether metals detected in site samples were the result of site-related activities or were indicative of naturally occurring conditions, the maximum metal concentrations measured in site samples were compared to the corresponding BTVs. Site sample metals concentrations less than or equal to the corresponding BTV represent the natural geochemical composition of media at FTMC, and not contamination associated with site activity. Site sample metals concentrations greater than the corresponding BTV represent contaminants that may be the result of site-related activities and require further assessment.

Thus, the first step in determining screening-level hazard quotients was a comparison of maximum detected constituent concentrations to appropriate ESVs. Constituents with HQ_{screen} values less than or equal to one were considered to pose insignificant ecological risk and were eliminated from further consideration. Constituents with HQ_{screen} values greater than one were eliminated from further consideration if they were macro-nutrients. Those constituents that had HQ_{screen} values greater one and were not considered macro-nutrients were then compared to their corresponding BTVs. If constituent concentrations were determined to be less than their naturally occurring background concentration, then a risk management decision could result in eliminating these constituents from further assessment. If a constituent was detected in surface soil at a maximum concentration that exceeded its ESV, was not an essential macro-nutrient, and was greater than the naturally-occurring levels at FTMC, then it was identified as a constituent of potential ecological concern (COPEC).

The COPECs that have been identified in surface soil at the Impact Area are presented in Table 1 and are summarized below:

- Selenium
- 4,4'-DDE
- 4,4'-DDT
- alpha-BHC
- beta-BHC
- dieldrin
- gamma-BHC (Lindane)

Ecological Risk Characterization. Selenium was detected in three out of ten samples at concentrations (0.891 to 0.977 mg/kg) that exceeded the ESV (0.81 mg/kg). The HQ_{screen} value for selenium was calculated to be 1.2, indicating the maximum detected concentration of selenium in surface soil only slightly exceeded the ESV. All of the selenium results were "J" flagged indicating that the concentrations were estimated. Furthermore, all of the selenium results were within the range of background. Alternative ESVs for selenium in soil range from 1.0 mg/kg for the protection of terrestrial plants (Efroymson, et al., 1997a) to 70 mg/kg for the protection of terrestrial invertebrates (Efroymson, et al., 1997b). All of the detected selenium results in surface soil were less than the alternative ESVs. Based on the low magnitude of the HQ_{screen} value, the detected concentrations relative to background, and the detected concentrations relative to the alternative ESV, selenium was not considered a COPEC in surface soil at the Impact Area.

Six pesticides (4,4'-DDE, 4,4'-DDT, alpha-BHC, beta-BHC, gamma-BHC, and dieldrin) were detected in surface soil at concentrations that exceeded their respective ESVs. 4,4'-DDE and 4,4'-DDT were detected in one surface soil sample within Parcel 136 Q-X at concentrations that slightly exceeded their respective ESVs. The HQ_{screen} values for 4,4'-DDE and 4,4'-DDT were calculated to be 1.08 and 1.04, respectively. Alpha-BHC and dieldrin were also detected in one surface soil sample within Parcel 136 Q-X at concentrations that exceeded their respective ESVs. The HQ_{screen} values for alpha-BHC and dieldrin were calculated to be 1.4 and 4.8, respectively. These two pesticides were detected in the same sample as 4,4'-DDE and 4,4'-DDT. Beta-BHC was detected in a single soil sample at a concentration the exceeded its ESV ($HQ_{screen} = 5.5$) and gamma-BHC was detected in two surface soil samples at concentrations that exceeded its ESV ($HQ_{screen} = 174$). These pesticides are not associated with Army training activities and are most likely present in surface soil as a result of historical pest control activities within the study area.

Because these pesticides were only detected in one or two samples at this site, it could be concluded that these constituents are not widely distributed within the study area. Although these constituents have the potential to pose adverse ecological risks to one or more ecological receptor groups based on a comparison to screening levels, larger animals with relatively large home ranges and foraging habitats would not be expected to be adversely affected by this localized contamination. The ESVs used for comparison are very conservative and are designed to be protective of the most sensitive individual organism. Specifically, the ESVs for the COPECs at the Impact Area were derived in the Netherlands as "target values" which are protective levels intended to achieve desired soil quality in the Netherlands (Ministry of Housing, Spatial Planning, and Environment, 1994). As such, these screening values may not be applicable to conditions at Ft. McClellan. Although these ESVs are very conservative, the magnitude of the HQ_{screen} values for all of these constituents except gamma-BHC is relatively low. Additionally, these COPECS are not mobile in the environment; therefore, they are unlikely to be transported significant distances from their source.

It is unlikely that the COPECs in surface soil at the Impact Area (Parcel 136Q-X) pose significant ecological risk based on the infrequency of detection, the limited areal extent of the detected constituents, and the concentrations at which these constituents were detected.

Table 1

Constituents of Potential Ecological Concern in Surface Soil
Impact Area, Parcel 136Q-X
Fort McClellan, Calhoun County, Alabama

Detected Constituents	Upper Background Range[a] (mg/kg)	Background Threshold Value[b] (mg/kg)	Ecological Screening Value[c] (mg/kg)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Minimum Detected Concentration (mg/kg)	Mean Detected Concentration (mg/kg)	Maximum Hazard Quotient	Mean Hazard Quotient	Constituent of Potential Ecological Concern
Volatiles :										
2-Butanone	NA	NA	89.6	2 of 4	0.018	0.016	0.014	0.00020	0.00016	1
Acetone	NA	NA	2.5	4 of 4	0.57	0.18	0.3725	0.228	0.149	1
Methylene chloride	NA	NA	2	3 of 4	0.006	0.0016	0.002825	0.0030	0.0014	1
Metals :										
Aluminum	39,900	16,300	50	10 of 10	10,600	1,970	7,584	212.00	151.68	3
Arsenic	49	13.7	10	10 of 10	2.53	0.824	2.03	0.253	0.203	1,3
Barium	288	124	165	10 of 10	47.7	19.1	30.51	0.289	0.185	1,3
Calcium	17,900	1,720	NA	10 of 10	156	67.9	110.00	ND	ND	2,3
Chromium	134	37	0.4	10 of 10	6.9	2.1	5.26	17.250	13.155	3
Cobalt	71	15.2	20	5 of 10	4.66	1.29	2.26	0.233	0.113	1,3
Copper	24	12.7	40	10 of 10	9	1.56	3.71	0.225	0.093	1,3
Iron	56,300	34,200	200	10 of 10	7,610	5,290	6,722	38.05	33.61	2,3
Lead	83	40.1	50	10 of 10	17.5	5.82	9.65	0.350	0.193	1,3
Magnesium	9,600	1,030	440,000	10 of 10	294	80.3	200.53	0.00067	0.00046	1,2,3
Manganese	6,850	1,580	100	10 of 10	202	14.5	77.42	2.020	0.774	3
Mercury	0.32	0.08	0.1	9 of 10	0.0595	0.0369	0.05	0.595	0.473	1,3
Nickel	22	10.3	30	10 of 10	2.5	1.28	1.97	0.083	0.066	1,3
Potassium	6,010	800	NA	9 of 10	344	98.7	176.82	ND	ND	2,3
Selenium	1.3	0.48	0.81	8 of 10	0.977	0.532	0.74	1.206	0.909	**YES**
Sodium	563	634	NA	2 of 10	59.5	24.3	49.16	ND	ND	2,3
Vanadium	158	58.8	2	10 of 10	12.4	3.62	9.46	6.200	4.728	3
Zinc	209	40.6	50	10 of 10	14.7	3.61	9.94	0.294	0.199	1,3
Herbicides :										
2,4-DB	NA	NA	0.1	1 of 4	0.012	0.0067	0.0104	0.12000	0.10425	1
Pesticides :										
4,4'-DDE	NA	NA	0.0025	1 of 4	0.0027	0.0027	0.0024	1.08000	0.96500	**YES**
4,4'-DDT	NA	NA	0.0025	1 of 4	0.0026	0.0026	0.0024	1.04000	0.95500	**YES**
Aldrin	NA	NA	0.0025	1 of 4	0.0012	0.00077	0.0011	0.48000	0.42700	1
alpha-BHC	NA	NA	0.0025	2 of 4	0.0035	0.0013	0.0018	1.40000	0.72000	**YES**
beta-BHC	NA	NA	0.001	1 of 4	0.0055	0.0022	0.0023	5.50000	2.25000	**YES**
Dieldrin	NA	NA	0.0005	1 of 4	0.0024	0.0014	0.0021	4.80000	4.17500	**YES**
Endosulfan II	NA	NA	0.119	1 of 4	0.0024	0.0018	0.0022	0.02017	0.01838	1
gamma-BHC (Lindane)	NA	NA	0.00005	2 of 4	0.0087	0.0024	0.0035	174.00000	69.00000	**YES**
Heptachlor	NA	NA	0.1	1 of 4	0.0019	0.0019	0.0014	0.01900	0.01350	1
Heptachlor epoxide	NA	NA	0.152	1 of 4	0.0013	0.0013	0.0012	0.00855	0.00789	1

Table 1

Constituents of Potential Ecological Concern in Surface Soil
Impact Area, Parcel 136Q-X
Fort McClellan, Calhoun County, Alabama

Detected Constituents	Upper Background Range[a] (mg/kg)	Background Threshold Value[b] (mg/kg)	Ecological Screening Value[c] (mg/kg)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Minimum Detected Concentration (mg/kg)	Mean Detected Concentration (mg/kg)	Maximum Hazard Quotient	Mean Hazard Quotient	Constituent of Potential Ecological Concern

[a] Upper background range as given in Science Applications International Corporation (SAIC), 1998 *Final Background Metals Survey Report, Fort McClellan, Alabama, July.*

[b] Background threshold value is two times (2x) the arithmetic mean of background metals (SAIC, 1998). For SVOCs, the BTV is the background screening value for soils adjacent to asphalt as given in IT Corporation (IT), 2000 *Final Human Health and Ecological Screening Values and PAH Background Summary Report, Fort McClellan, Calhoun County, Alabama*, July.

NA - Not available.

ND - Not determined.

Rationale for exclusion as a COPEC:

1 - maximum detected concentration less than ESV

2 - essential macro-nutrient

3 - maximum detected concentration less than BTV

4 - no ESV available, maximum detected concentration less than ESV for similar compounds